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A Summary of Current Program 7/1/65
and Preliminary Report of Progress
for 7/1/64 to 6/30/65

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STANDARDS AND RESEARCH DIVISION
of the
STATISTICAL REPORTING SERVICE
UNITED STATES DEPARTMENT OF AGRICULTURE
and related work of the
STATE AGRICULTURAL EXPERIMENT STATIONS

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CURRENT SERIAL RECORDS

This progress report is primarily a tool for use of scientists and administrators in program coordination, development, and evaluation; and for use of advisory committees in program review and development of recommendations for future research programs.

The summaries of progress on USDA and cooperative research include some tentative results that have not been tested sufficiently to justify general release. Such findings, when adequately confirmed, will be released promptly through established channels. Because of this, the report is not intended for publication and should not be referred to in literature citations. Copies are distributed only to members of Department staff, advisory committee members, and others having special interest in the development of public agricultural research programs.

This report also includes a list of publications reporting results of USDA and cooperative research issued between July 1, 1964 and June 30, 1965. Current agricultural research findings are also published in the USDA publications, Agricultural Economics Research and Farm Index. This progress report was compiled in the Standards and Research Division, Statistical Reporting Service, United States Department of Agriculture, Washington, D. C.

UNITED STATES DEPARTMENT OF AGRICULTURE

Washington, D. C.

July 1, 1965

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INTRODUCTION

There are three Divisions in the Statistical Reporting Service: Agricultural Estimates, Field Operations, and Standards and Research. The Agricultural Estimates Division is located in Washington, D. C. It administers crop and livestock estimating programs designed to provide current information about crop acreages and production, livestock numbers, and other statistics pertaining to the agricultural economy. The Field Operations Division has its headquarters in Washington, D. C., but it administers the field operational activities of the crop and livestock estimating and reporting programs through the medium of 43 field offices which serve the 50 States. The Standards and Research Division, also located in Washington, D. C., administers programs which include the research activities of SRS as well as statistical clearance. The research is conducted by the Special Surveys and the Research and Development Branches; both Branches perform service as well as research activities.

The Special Surveys Branch conducts research on the behavior, opinions, and preferences of consumers which affect their purchase and use of agricultural products or end products. These studies provide information of value in planning improved marketing of agricultural products, setting or revising grades and standards, and indicating areas requiring technical research to provide product qualities and characteristics which more closely satisfy consumer demand. The findings can be utilized to increase marketing and merchandizing efficiency all along the distribution line so that returns to producers can be improved and at the same time the satisfaction of consumers increased. The Special Surveys Branch also conducts research on reactions of agricultural programs and services which is designed to provide insights into measures which might be taken to increase their effectiveness.

The Research and Development Branch conducts research on sampling and survey methods as applied to the data collection activities of SRS, and development of techniques of statistical measurement applicable to substantive research.

The work of these Branches is being performed by a staff of about 22 professional employees. Part of the research is conducted by contract with private research organizations and cooperative agreements with land-grant colleges or producer and processor groups. On occasion, funds are transferred to the Division by other government agencies or farm organizations to finance special research studies undertaken at their request.

Some of the more noteworthy recent applications resulting from the research conducted by the Division are outlined below.

Results of studies conducted by the Special Surveys Branch on consumers' opinions of agriculturally-produced materials in various end uses have been used by natural fiber organizations to evaluate the position of cotton and wool in specific segments of the textile industry, and to encourage and guide private industry's efforts to improve the attributes of natural fibers so that they can compete more successfully with synthetics. In addition,

each year the National Cotton Council of America bases a major portion of its promotion for consumers and retailers on these research results; these reports have also been used as standard examples in the market development program of Cotton Council International.

The results of a study acceptance by a panel of consumers of instant sweet-potato flakes, which were developed by the Southern Utilization Research and Development Division, ARS, indicated considerable commercial potential for the new product. This conclusion is similar to that drawn from the results of an earlier study to measure consumer's reactions to instant white potato flakes. The acceptance of the white flakes has been a major contributing factor to halting the downward trend of per capita potato consumption. In the relatively short period of time since the publication of the final results of the sweetpotato flakes survey, at least four processors have begun producing the sweetpotato flakes at an estimated annual production of three million pounds. Furthermore, the capacity of the current processors is approximately four to five million pounds. Since it takes eight pounds of raw sweetpotatoes to yield one pound of instant, the contribution to the utilization of sweetpotatoes is significant.

The Special Surveys Branch has also conducted a number of studies in cooperation with the Economic Research Service to evaluate the market potential for new or improved products developed by the USDA's Utilization Research Regional Laboratories. One of these projects indicated that a new super-concentrated apple juice, which was processed in such a way that the fruit juice aromas which would otherwise be lost were recovered, was well received by household consumers in a test market city. The firm that originally cooperated with the Department in the first market test of the new juice subsequently undertook production of the juice with some variations from the Eastern Utilization Research and Development Division's original process. Preference tests in the Special Surveys Branch's sensory evaluation laboratory indicated that the variant product was much less acceptable to consumers than juice prepared by the original process. Market tests of the variant product were discontinued pending further technical research on product improvement.

The improved survey methods developed by the Research and Development Branch are being put into operation by SRS as rapidly as resources will permit. In December of 1964, full-scale enumerative surveys were conducted in 32 States. In June 1965, the enumerative survey program was expanded to include 39 States at an operating level, and pilot surveys in 9 States. Objective yield surveys for corn and cotton were also conducted--corn in 23 Southern and Central States, and cotton in 10 Southern States. The 1965 winter wheat survey included 15 States. The research program which produced the methodology for these surveys is coming into fruition through their incorporation into the operating program of SRS. Work is being continued both in survey methods and in objective yields.

AREA NO. 1: CONSUMER PREFERENCE AND QUALITY DISCRIMINATION--
HOUSEHOLD AND INDUSTRIAL

Problem. With the increasing complexity of marketing channels and methods, it has become almost impossible for consumers to express to producers either pleasure or displeasure with available merchandise. To market agricultural products more effectively, it is necessary to understand existing household, institutional, and industrial markets and the reasons behind consumers' decisions to purchase or not to purchase. Information is needed on consumers' attitudes toward old and new product forms of agricultural commodities, preferences, levels of information or misinformation, satisfactions or dislikes, and what product characteristics would better satisfy current consumers and/or attract new ones. It is also important to know the relationship between the consumption of one agricultural commodity and another in consumers' patterns of use, the relationship between agricultural and nonagricultural products, and probable trends in the consumption of farm products. Producer and industry groups as well as marketing agencies consider such information essential in planning programs to maintain and expand markets for agricultural commodities which, in turn, increases returns to growers.

USDA PROGRAM

The Special Surveys Branch conducts applied research among representative samples of industrial, institutional, or household consumers and potential consumers. Such research may be conducted to determine preferences, opinions, buying practices, and use habits with respect to various agricultural commodities; the role of competitive products; acceptance of new or improved products; and consumers' ability to discriminate among selected attributes of a product or levels of an attribute, and the preferences associated with discriminable forms.

In addition to the studies of consumer preference and discrimination, the Branch also provides consultants and conducts special studies, upon request, for other agencies in the USDA or within the Federal Government, when survey methods can be usefully applied to the evaluation of programs, services, or regulatory procedures of interest to the requesting agencies.

The research is carried out in cooperation with other USDA or federal agencies, State experiment stations, departments of agriculture, and land-grant colleges, and agricultural producer, processor, and distributor groups. Closely supervised contracts with private research firms are used for nationwide surveys; studies in selected areas are usually conducted by the Washington staff with the assistance of locally recruited personnel.

The Branch maintains all of its research scientists, who are trained in social psychology or other social sciences, in Washington, D. C., which is headquarters for all the research whether it is conducted under contract or directly by the Branch. The Federal scientific effort devoted to research in this area during the past year totaled 7.0 professional man-years. An additional .1 professional man-year was devoted to research conducted under a transfer of funds arrangement.

REPORT OF PROGRESS FOR USDA AND COOPERATIVE PROGRAMS

A. Consumer Preference

1. Fibers in wearing apparel. The rapid expansion in recent years in the use of manmade fibers and blends necessitates up-to-date evaluations of consumer reactions to natural fibers in specified end uses. Such data give industry a better understanding of its markets, and provide a guide for planning physical science research in industry and within the Department on product improvement as well as educational, promotional, and merchandising efforts designed to strengthen the market position of cotton and wool.

A preliminary report on the results of a contract study on reactions to fibers in selected items of clothing among a nationwide sample of teenage boys and girls was issued during the fall of 1964; a final report presenting more detailed findings is in preparation. Data from the study have been discussed in a previous progress report.

The exploratory phase of the nationwide contract study of women's opinions about fibers in apparel for warmer weather was completed. In the exploratory interviewing, groups of women were studied in depth to determine their attitudes and opinions with respect to certain items of clothing and the fibers in them. The findings guided the designing of two types of questionnaires for use among comparable samples of women. This will permit detailed evaluation of the advantages and disadvantages of the two methods. One of the questionnaires is composed mainly of structured questions; the other uses the traditional open-end questions to collect the attitudinal responses. The pretest for this study is scheduled for July; actual field work is planned for early fall of 1965.

2. Poultry. A nationwide survey is being conducted under contract by a private market research firm to ascertain household consumers' preferences, use patterns, and purchasing practices for broilers-fryers and turkeys. Data from the study will provide insights into the measures which might be taken by the poultry industry to market their products more effectively and to increase demand among consumers. To supply information about trends in preferences and attitudes among representative consumers, some questions were replicated from an earlier (1956) study. The data will also be of value to market specialists and technologists in the Department who are interested in doing further developmental work on convenience items, or in shaping new markets for products having marginal characteristics. A

preliminary report on the study has been issued. Additional data analysis and preparation of the final report are underway. According to the preliminary analyses, the proportion of homemakers reporting usage of broilers or fryers has increased since 1956 from 93 to 97 percent. Frequency of usage has also increased; 64 percent of the users in 1964 reported serving broiler-fryers once a week or more compared to 50 percent in 1956. Homemakers with larger families tended to use broiler-fryers more often. Most homemakers reported being able to purchase broiler-fryers in the weight range which suited their family's needs. Purchasers were asked to choose from a list of specified items those characteristics which they felt were most important in selecting broilers or fryers. About 70 percent chose "one that is well cleaned," "no bruises or discoloration," and "the right size." About 60 percent selected "inspected by the government," and a little over 50 percent selected "no pinfeathers," and "plumpness." About 40 percent said they "depend on the store" while only 20 percent indicated that the brand name was important in their selection process.

When asked which of three poultry grade labels--words, letters, or numbers--would be the easiest to understand, almost 60 percent selected words, while 30 percent chose letters. Only 5 percent felt that numbers would be easier to understand.

The results of the two surveys turned up some changes during the last decade in the ways homemakers prepared chicken for their families. Frying was the most popular method in both surveys. But its popularity has declined slightly, while increases were reported for other methods such as baked or roasted, broiled, and barbecued.

Outdoor cooking increased considerably. In the 1964 study, 35 percent of the homemakers said they had cooked broiler-fryers outdoors. Only 11 percent reported doing so in 1956.

The proportion reporting use of turkey (76 percent) increased by 11 percent since 1956, although turkey is still served rather infrequently. About the same proportion of users (3 out of 4) in both surveys reported a rate of serving of only 1 to 3 times during the year.

3. Milk. The study of milk consumption patterns in Milwaukee, Wisconsin, and New Orleans, Louisiana, with particular emphasis on low-fat (sometimes called two percent milk) has been completed. The final report on this study, which was conducted in cooperation with ERS, was published in May 1965.

In Milwaukee, where low-fat milk has been available since 1951, about 15 percent of the families interviewed had used low-fat milk within six months prior to the survey. In New Orleans, where low-fat milk has been available only since 1957, about 6 percent of the families had used low-fat milk within six months of the interview. Low-fat milk makes its primary appeal to diet-conscious customers. More than 8 out of 10 of the families using low-fat milk had a dieter or weight watcher in the household. Low-fat milk is also more apt to be tried by the relatively high-income household.

The majority of the families using low-fat milk in both cities were satisfied with the price. However, a somewhat higher proportion of families in New Orleans thought the price they paid was too high. In New Orleans, low-fat milk was not only more expensive than it was in Milwaukee, but it also cost more than whole milk.

A contract (financed in part by ARS) has been signed with a local university research group to conduct a survey to evaluate consumer acceptance of powdered dry whole milk, a new product developed by the Dairy Products Laboratory of the Eastern Utilization Research and Development Division, ARS. At this time, the product compares favorably with fresh whole milk when tested under controlled conditions (see Quality Discrimination Section), and looks commercially feasible for distribution under refrigeration. However, the reaction of the housewife to the reconstitution behavior of the product and the residual foam on the surface of the reconstituted milk are untested and unknown. Evaluation of the product by consumers under natural conditions is, therefore, felt to be desirable not only to mark the extent of present progress but also to indicate lines along which further research on the product should proceed. The field work on this study is planned for the early fall of 1965.

4. Noncitrus fruit. A preliminary report has been published, and a final report presenting more detailed findings is in preparation on a nationwide contract survey among homemakers to ascertain the frequency and patterns of use for selected noncitrus fruits as well as the attitudes and opinions which influence their use or nonuse.

All homemakers were asked which of the following fruits they had purchased in the past 12 months. More than 80 percent of the homemakers said they had bought fresh bananas, apples, grapes, and peaches. Between 40 and 70 percent had purchased fresh pears, plums and prunes, sweet cherries, and nectarines. Less than 30 percent had bought fresh pineapple and apricots.

Respondents were asked what they thought a store manager could do to get customers to buy more fruit. Nearly half the homemakers feel consumers would buy more if stores displayed higher quality fruits. About 1 in 4 feel more attractive displays or lower prices would increase sales.

Homemakers usually prefer to purchase unpackaged fruit. Buying loose fruit permits homemakers to select the number and size they want and to inspect the fruit for bruises and spoilage. However, many mentioned the advantages of packaging; it is time saving and sanitary.

5. Potatoes, rice, and wheat. A contract has been signed with a private research firm to collect information from a nationwide sample of homemakers on their use of and opinions about selected potato, rice, and wheat products. The study is designed to ascertain household consumers' preferences and buying practices for these commodities, including specialty or highly processed convenience-type food products, and to identify the characteristics

which consumers consider to be important in selecting such food products and to determine their satisfaction with items currently available. The field work on this study is planned for the fall of 1965.

B. Quality Discrimination

The sensory testing laboratory of the Branch is used to ascertain, under controlled conditions, people's abilities to discriminate among qualities or levels of a quality for food samples, or other sensory or visual stimuli, and the preferences associated with discriminable variables. The products which have been evaluated include new food forms developed in the ARS laboratories or variations of products already available. Studies have been conducted this year on apple juice, milk, and an apple-grapefruit juice blend. Studies on Hawaiian coffee are in progress and research on grapes is planned. Some examples of the types of problems investigated are listed below. The results of these studies have not been published, but were reported by memorandum to the cooperating group requesting the research.

Milk. Three commercial products (fresh whole milk and fluid and dry nonfat milk) were procured on the market place for comparison with an experimental dried whole milk developed by the Eastern Utilization Research and Development Division, ARS. The nature of the comparison was preference. Results of the study indicated that the experimental dried whole milk was as well liked as fresh whole milk, and that the experimental product was preferred to the other two commercial products.

Apple juice. People's preference for six apple juices, including an experimental type 6-to-1 concentrate, were determined under normal and under greatly reduced illumination. The experimental juice was liked as well as the controls under both lighting conditions.

In a related study, people rated two cloudy and two clear apple juices on their appearance. The clear apple juices were judged to be of better quality than the cloudy ones.

Blended juices. Research has been conducted on people's preference for different proportions of apple to grapefruit juice in a blend. Preference for an apple-grapefruit juice blend has also been compared with that for commercial blends, orange-grapefruit, pineapple-grapefruit, currently on the market. Data from these studies are being analyzed.

PUBLICATIONS

Owings, Ann. Sept. 1964. Young People's Use and Appraisals of Natural and Competing Fibers Used in Wearing Apparel--A Preliminary Report. SRS-4. (S&R 3-1).

Clayton, L. Yvonne. May 1965. Homemakers' Use of and Opinions About Selected Fruits and Fruit Products--A Preliminary Report. SRS-6. (S&R 3-6).

McCoy, John L. May 1965. Homemakers' Opinions and Preferences for Broiler-Fryers and Turkeys--A Preliminary Report. SRS-7. (S&R 3-8).

Moede, Herbert H., and Burnside, Betty. May 1965. Market Potential for Low-Fat Milk. Marketing Research Report No. 709. (S&R 3-7).

AREA NO. 2: IMPROVEMENT OF CROP AND LIVESTOCK ESTIMATING PROCEDURES

Problem. The Statistical Reporting Service produces a large number of current statistics pertaining to agriculture. Because of limited resources, statistical methods were devised with a view to producing the most information for the least cost. These methods are subjective in nature and are based largely upon self-selected samples from voluntary crop reporters who fill out and return mailed questionnaires. The information is generally collected in the form of relatives such as acres this year compared to last, and crop condition as a percentage of full crop. Persistent bias is removed by charting, and census or other check data are generally projected to form current estimates. Estimates based on these sample methods have proved relatively satisfactory over the years. However, in seasons when changes are unusually large, the changes may not be fully reflected in the appraisals and reports of the respondents to mailed questionnaires. In situations like this, when accuracy is needed most, the estimates may lack the required precision. Then, when the estimates are translated into available supplies for the different commodities, price inequities may occur and, as a result, producers or the processors of agricultural commodities may suffer serious financial loss.

With the development of modern statistics, new methods based upon probability sampling have been developed. Although surveys based upon probability sampling are more expensive to conduct than the traditional self-selecting mailed survey, these new methods offer a means of increasing the precision and reliability of the estimates. Because of the need by the agricultural economy for high quality statistics, it is mandatory that the statistical theory and methods be developed and adapted to the collection of agricultural statistics. Some of the new procedures have already been introduced but there is an urgent need for a continuing research to devise efficient survey methods so as to make possible continuing improvement in the quality of SRS statistics.

USDA PROGRAM

The Department of Agriculture conducts a program of applied research designed to strengthen and improve the methodology used in collecting agricultural statistics. The principal disciplines involved are mathematics, statistics and probability, but other disciplines relating to a particular problem are brought to bear as required. Examples of these are plant physiology, psychology, cartography and photogrammetry. The current program consists of 6.0 professional man-years per year devoted to the study of sample and survey methods, and 4.0 professional man-years working on methods for forecasting and estimating the yields of important crops. Work under this program is done in Washington, D. C., and in SRS field offices located in the States concerned.

Research objectives in survey methods are concerned with the improvement of all aspects of survey design. These include questionnaire and form design, universe definition and sampling frame construction, sample design and estimators, enumeration techniques, quality checks, editing procedures, methods of processing data and the post-analysis of the survey with a view to improvement of design. In the current program priority is being given to completing the construction of an area sampling frame for the New England States; to the investigation of sources of lists, their maintenance and optimum use as sampling frames for probability sampling; and to the problem of developing methodology for collecting data by mail and enumeration in the same sample survey using lists in conjunction with area as frames. A preliminary exploration of the possibility of using aerial photography in estimating acreages of crops and numbers of livestock is being made. In this area, problems requiring study are those of sample design and photo-interpretation as well as the use of this technique to supplement a general-purpose survey. Response errors are being studied. Here the objective is to establish communication with the respondent through the medium of a questionnaire which will transmit concepts with a high degree of fidelity and at the same time induce the respondent to reply, and reply honestly and fully. An attempt is being made to distinguish between those items for which the respondent has accurate knowledge, those items which he may have once known but no longer recalls accurately, those items which he had never known precisely, and those items for which he is unwilling to divulge information or gives deliberately misleading information. Where applicable, alternative sources of information will be sought and different ways of motivating respondent cooperation will be tested.

Work on objective yields is being continued. This includes the refinement of the forecasting models being tested as well as the development of forecasting procedures for other important crops. Corn, cotton, wheat, and soybean models are being refined by computing parameters based upon larger samples and by broadening the range of plant maturity recognized by the model. Among the other crops for which objective forecasting procedures are being developed are apples, onions, and pasture grasses. Procedures for forecasting sorghum yield have been developed and are now ready for field tests.

REPORT OF PROGRESS FOR USDA AND COOPERATIVE PROGRAMS

A. Objective Measurement of Yields

1. Wheat. The wheat program in 1965 is basically the same as 1964. However, refinements in data collection, forecast models, and ADP processing are to be noted. During 1965 there were slight differences in allocation of samples to the nine fully operational States. In these States a total of 1,320 fields was sampled for pre-harvest estimates. In 1965 there were further reductions in the number of sample fields for post-harvest observations. The amount of variation found was smaller than expected and made

this reduction possible. The sample size in the six western winter wheat States was increased from 280 sample fields to 360 in 1965. This was done to increase precision for the pre-harvest estimate. Also, increases in the early season number of sample fields gave a broader base from which to establish stable forecast models. Sample sizes were also increased for spring and durum wheat. For the pre-harvest survey in the States where the study is being conducted, the number of sample fields for other spring was increased from 340 to 420, and from 80 to 120 for durum.

The 1964 weekly development data established growth curves which were consistent with previous results. The other purpose of the 1964 weekly development work was to provide data for optimum size and shape of plot. This data has been only partially analyzed, and more analysis is necessary before any changes in present methods will be considered.

A general purpose computer analysis program has been developed and will be used in 1966. The use of this program will permit full utilization of all available variables in determining and keeping up to date the best possible forecast models.

During 1965 a number of projects were initiated to improve and complement procedures in forecasting and estimation. The model for forecasting weight per head in maturity stages 4 (milk) and 5 (soft dough) is being improved by increasing the number of heads on which grain counts are made. Considerable variation in the ten head subsample now being obtained has contributed to a low coefficient of determination. By using two pieces of specialized equipment, an electronic seed counter and a micro thresher, the Oklahoma office is testing the feasibility of threshing, after a drying period, heads clipped from an entire row section (approximately 24 inches long).

Current forecasting and estimation procedures do not include lodged grain in forecasts or pre-harvest estimates of yield. This grain is picked up at the time of the post-harvest gleaning and called harvest loss. The harvest loss is then deducted from the estimated yield. Since such grain was not included in the estimate this procedure in effect removes this amount twice. The quantity of grain is relatively insignificant for most samples but because of hail or some other damage a few samples might be affected significantly. This year to evaluate the effect of this procedure a pre-harvest gleaning will be done in two States. Enumerators were instructed to glean all grain and heads from the ground after the unit is clipped on the final pre-harvest visit.

Because of full automation of the wheat forecast and estimation processes the need for exact input data has become vitally important. During 1965 a comprehensive ADP edit program was developed, to complement the manual edit performed in the field office and to assure error free input data.

2. Soybeans. In 1964 the soybean objective yield study was conducted in 440 sample fields on August 1 and September 1. This was increased to 1,180 sample fields for the final pre-harvest visit in 9 North Central States,

Arkansas and Mississippi. Field procedures were changed so that plants within the six-inch row section beyond each sample unit were used for the detailed counts in 1964 instead of the first two plants. This change doubled the number of plants used for detailed counts and eliminated the bias in the number of pods with beans which was observed in previous years.

During 1964, weekly counts and observations were made in 20 fields in Iowa, Minnesota, Ohio and Mississippi during the growing season. From the analysis of this data and 1962, 1963, and 1964 monthly data, 11 maturity categories were established to help find more reliable forecasting models for August 1 and September 1. Nodes per plant, ratio of blooms to total fruit, and ratio of pods with beans to total fruit, are the criterion used for classifying the maturity stage of the sample. Usually 6 maturity categories will classify the samples encountered during a particular survey month. For the August 1 forecast, two models are being developed to forecast the number of pods with beans at harvest. For one model, the procedure is to forecast maximum fruit load and to reduce it by the fraction of expected loss to obtain the predicted number of pods with beans. The other model employs multiple-regression equations to predict the number of pods with beans for each maturity category within a State. This same type of model is being developed for the September 1 forecast. Some of the variables used in these models are plants per standard unit, nodes per plant, pods, and pods with beans per plant.

Weekly counts and observations will be continued during the 1965 growing season in 20 fields in Illinois, Indiana, Missouri, and Arkansas. Beans from the weekly samples will be sent to Ames, Iowa for analyses of the Iodine Number, oil content and percent protein. These will be studied as possible variables for forecasting final bean weight on September 1.

3. Irrigated cotton. This study was continued on a larger scale (310 sample fields) in 1964 to test previous results, and to obtain data for refining forecasting parameters and early season models. Based upon this study and the earlier studies, the following changes were made in the forecasting program for 1965:

- (1) Total samples assigned in the three Western States were increased from 320 to 480 in order to more nearly approximate the degree of precision desired at an operational level.
- (2) California was divided into two distinct areas of production-- the Imperial Valley and the San Joaquin Valley area.
- (3) One early season forecasting model was altered in New Mexico and the San Joaquin Valley area of California.

Further refinement can be expected in the forecasting parameters as data are accumulated over years from the increased number of sample fields.

4. Sorghum. A sorghum objective yield study has been conducted since 1959 under a cooperative agreement with Iowa State University. This study was an attempt to establish procedures which could be used for operational use in the forecasting and estimation of grain sorghum yield and production.

The study during 1964 was concerned primarily with gaining additional experience with procedures investigated previously rather than investigation of new procedures. Gleaning operations were conducted as in 1963. In 1964 the farms used in the study were not randomly selected. Farms from previous years were used where possible. The number of farms was reduced in 1964 to a total of 36 farms, the number of plots and heads to be observed on each farm was increased by half, and the number of visits was increased from three to five. Thus, each farm was visited five times--the first week in August, September and October, and the middle of August and September.

Comparisons of plot and head characteristics (1961-1964) were made with 1964 results being generally consistent with the previous years' results. In estimating the final number of heads per foot of row the August plants per foot and heads per foot as a percent of plants provided the largest coefficient of determination. The multiple regression technique used to predict dry kernel weight was based on plants per foot, dry kernel weight, August indicator, percent dry matter and percent heads gave a multiple R^2 of 0.67, compared to 0.71 in 1963, 0.66 in 1962, and 0.50 in 1961. The predicted yield was again well above the estimated yield at harvest. Since the independent variables are not measured without error a multiple regression analysis was done on grouped farms rather than individual farms. It was believed that by grouping the effect of measurement error in the independent variables upon the estimated coefficients would be reduced. The grouping was done on the basis of percent dry matter. Only for the group with the highest percentage of dry matter was the predicted yield relatively close to the estimated yield at harvest.

This year, as in 1963, graphic techniques were utilized in an attempt to portray the growth in dry kernel weight as a function of percent dry matter. Predictions for previous years (1961-1963) were better than the prediction obtained from 1964 data. Furthermore, predictions for 1964 based on 1963 analysis were generally more accurate than those based on the 1964 analysis. It is difficult to determine why the predictions for 1964 are so much poorer than for the preceding years. The suggested reasons are: technique needs further refinement, 1964 did not have a typical growing season, and the analysis is based on relatively few farms.

While the 1964 results do nothing to substantiate the utility of the prediction techniques employed earlier, neither do they seriously undermine them. It is suspected that if this investigation was carried out in the more important sorghum producing areas more consistent results could be obtained.

5. Onions. Objectives of the 1964 study of onion development in Michigan were to investigate methods of determining and defining stage of maturity and to establish a growth curve. Analysis of 1964 weekly development data

opened several new areas of interest. It was thought that dry matter might be used to determine stage of maturity. It turned out that the percent dry matter content in onions is nearly constant regardless of the size or stage of maturity of the onion. Bud formation was also studied with the idea that the number and size of buds in immature plants might have an effect on the weight of the bulb at maturity. Here it was found that the development of buds varies not only between varieties but within the same variety. The variation in number and size of buds at a given stage of development was too great to give a valid indication of final bulb size. Grouping of bulbs from each weekly sample into 3 size groups, less than 1 inch, 1 to 2 inches, and 2 inches plus, proved to be a good procedure for analysis of the growth pattern over the season. The addition of the 1964 weekly data to previous years data pointed out the need for more work to stabilize the late season growth pattern. From this work it appears that the best method of determining maturity is date of planting and days after planting for a given variety or perhaps a group of varieties.

During 1965 the program was continued by using three of the varieties that had been planted in past years. Location and planting dates were also comparable to 1964. New items of study include field stratification, based on row density, to aid in stabilizing the late season growth curve. Data on leaf count and height and diameter of the plant at the bulb juncture are being collected to determine their relationship with bulb weight.

B. Survey Methods

1. List Frames. A list of livestock owners (the ADE list) was compiled in Wyoming by the Agricultural Research Service in cooperation with the Wyoming office of SRS. The list was prepared from January 1963 county tax assessment records. In general, the numbers of acres and livestock by species, on which taxes were paid, were listed along with the ranch headquarters location in terms of range, township and section number.

Resident farm operators from the June 1964 Enumerative Survey were matched against names from the ADE list to estimate the degree of coverage of the list. For the State, 83 percent of the resident farm operators and 86 percent of those operators reporting livestock were matched. In terms of livestock numbers, 92 percent of the cattle and 99 percent of the sheep reported in June 1964 were reported by operators whose names were included on the list.

In order to evaluate this list for possible use as a sampling frame, singly or in combination with other frames, a sample was designed and selected for enumeration during the last week of May and the first two weeks of June 1965. A four page livestock and poultry questionnaire was designed which included 15 questions for defining a sampling unit or operation. These questions include acres and location of land owned, rented, managed, and land operated under a partnership. Also, it was designed to obtain names and addresses of

other people associated with each parcel of land so that possible duplication could be identified.

For sampling purposes, known duplication, outside-of-state locations and June Enumerative Survey extreme operators were removed from the list. The remaining names were stratified as follows:

- (1) Operators with sheep
- (2) Operators with cattle, no sheep
- (3) Operators without cattle or sheep

A sample of 127 names was then drawn from the list. These operators were mailed the livestock questionnaire in late May and all non-respondents were interviewed. Reports from the list were summarized and combined with the results from the June survey using a multiple-frame approach. If livestock estimates are the primary interest and costs considered, the analysis shows that the list frame should be sampled much heavier while using a smaller sample from the area frame. Multiple frame estimates (combines all data from list sample with data from area sample) for livestock inventories show gains in precision of from 50 to 600 percent.

In 7 counties the headquarters location information was used in constructing a new area frame. These locations were plotted on county highway maps and new area sampling units defined to include about two farm or ranch headquarters. These new segments were enumerated for livestock using the open-segment approach. Results of this work is being studied and comparisons made with the expansions from the June Enumerative Survey. It appears that this technique of segment construction will tend to equalize size of sampling units for most livestock items, and should be effective in controlling variation, as compared with the procedures currently used in constructing segments.

2. Probability Mailing List. Analysis of the data collected in Iowa and Alabama for this project in 1961 shows that the selectivity bias in estimates from the mailed returns was 7.0 to 11.6 percent upward for major livestock items in Iowa. However, when the total for a species was broken down into subclasses, there was no consistent trend in the bias. In Alabama, cattle was the only species for which the bias is relatively similar to that found in Iowa. Other species totals were all negatively biased. The selectivity bias, for land operated, as a percent of the estimates from mailed returns, was plus 11.6 percent in Iowa and minus 24.6 in Alabama. Apparently when reporting by mail, many respondents in Alabama tended to include only cropland or some fraction of the total land which they actually operated.

For the Iowa data, a "ratio-to-land estimator" would have provided relatively unbiased estimates from the mailed returns for major items, but not for subclasses, and in Alabama would not have been effective in minimizing selectivity bias for any item.

An analysis of results by "Interest groups" (based on an Interest Index developed from "screening" data collected when the probability list was established) has revealed no consistent relationships which might be used to remove or eliminate non-response bias from estimates based only on mailed returns. Work is still continuing in this area.

To obtain independent data for examining relationships indicated by the 1961 study, a new phase of this project was started in 1965. Six States: Alabama, Georgia, Iowa, Illinois, Nebraska, and North Carolina were included in this study. A probability list of farm operators was obtained from the segments rotated out of the June Enumerative Survey for 1964 and 1965, i.e., one-half of the list for each State came from segments enumerated in 1963, the other one-half was enumerated in 1964.

Three different questionnaires were designed for use in this study. One-third of the sample list was mailed a "cattle" questionnaire, one-third a "hog and pig" questionnaire, and the remaining one-third a "general livestock" questionnaire. The cattle questionnaire contained 26 questions, the hog and pig questionnaire 30 questions, and the general livestock questionnaire 48 questions. Response rates by mail, after a reminder by phone or letter, showed no significant differences between questionnaires. For the cattle questionnaire, 41.0 percent was returned by mail compared with 41.4 percent for the hog and pig questionnaire, and 41.5 percent for the general livestock questionnaire.

A comparison of results for Iowa and Alabama with results from the 1961 data shows some similarities between the two periods. Land operated as reported by mail is still positively biased for Iowa (+2.7 percent compared with +11.6 percent in 1961) and negatively biased in Alabama (-18.4 percent compared with -24.6 percent in 1961). All hogs and pigs in Iowa showed about the same bias as in 1961, +9.9 percent compared with +10.1 percent; however all cattle was negatively biased (-7.4 percent compared with +10.9 percent in 1961). For Alabama all major items reported by mail were negatively biased. Analysis of this data is still continuing in an effort to develop procedures for eliminating or minimizing the effect of non-response bias in estimates from data obtained by mail.

3. Aerial Photography as a Supplementary Technique in Making Crop and Livestock Estimates. A preliminary feasibility study for using aerial photography to obtain inventories of crops and livestock was made in 1963. Additional work was performed in 1964-65 under a cooperative agreement with the School of Forestry, University of California at Berkeley with the purposes of, (a) developing keys for identifying livestock, first by species, and then insofar as possible by age and type of individuals; (b) developing keys for identifying crops by general types of land use, and by species; and (c) to determine which film-filter-camera-time of day combinations would be most desirable. Primary emphasis of this year's work was on parts (a) and (c).

Development of the livestock keys and research into film-filter combinations began with simulated aerial photographs taken from a water tower. Keys were then developed based upon animal characteristics observed in these photos. These keys were tested on aerial photography taken at 13 different locations within California and at different seasons of the year. This photography was taken using both Aerial Ektachrome and Panchromatic type films with a Zeiss 6" focal length aerial camera. The Hy-Ac 12" focal length panoramic type camera developed by Itek Corporation was also used on occasion. Slight modifications in the livestock identification keys were made as a result of these tests.

Other conclusions reached as a result of these tests included: (1) Aerial Ektachrome is preferable to Panchromatic film in all respects for identifying livestock (but is considerably more expensive); (2) livestock are more easily detected (using either color or black and white film) against the green background associated with the winter and spring seasons in central California than they are during the summer and fall when vegetation (other than irrigated pastures) is brown and dry; (3) photography of livestock on range or in non-irrigated farm pastures during warm weather must be taken during the early morning or evening hours when livestock leave the shade to feed; (4) conversely, photography of dense congregations of animals in feedlots and irrigated pastures would be most desirable near noon when shadows of buildings, fences, etc. would be less likely to obscure the animals; and (5) to inventory livestock efficiently through the use of aerial photos, the areas to be surveyed must have a minimum of tall vegetation and/or livestock in farm buildings.

4. Sampling Procedures in the Eastern States. The construction of a new area sampling frame which was initiated for 13 States in 1964 was completed for New Jersey, Delaware, Maryland, and West Virginia. In these States the entire land area was classified according to its current use. The primary land use strata were, (1) intensively farmed land, (2) extensively farmed land, (3) land used primarily for urban, business or industry purposes, and (4) non-agricultural land (open land that contains little or no agriculture). The new frame was used as a basis for allocating sampling units for the June 1965 Enumerative Survey in these four States. Results from the June 1965 Survey in these States showed substantial efficiencies in sampling errors and data collection. Information obtained from the pilot 1964 June Survey in the three States for which the frame had been completed (New York, Pennsylvania, and Florida) showed that some additional controls on size and number of farms per sampling unit in the extensively farmed land stratum would improve the efficiency of the frame. These controls were used in this stratum in drawing the 1965 June Survey segments for all seven States. A large portion of the additional frame construction work for the New England States was completed, particularly for the urban, business and industrial stratum where new land use maps and materials became available through county or State agencies.

Line Project Check List -- Reporting Year July 1, 1964 to June 30, 1965

Work & Line Project Number	Work and Line Project Titles	Work Locations During Past Year	Line Proj. Incl. in	
			Summary of progress	Area & sub-heading
S&R 3	Household and Industrial Consumer Attitudes and Sensory Discrimination Studies.			
S&R 3-1	Young People's use and appraisal of natural and competing fibers used in wearing apparel.**	Washington, D.C.	Yes	1-A-1
S&R 3-4	Study of the effect of selected characteristics of fresh citrus fruit on trade and consumer acceptance.	Washington, D.C.	No	
S&R 3-6	Consumer preferences, usages, and buying practices for noncitrus fruits.**	Washington, D.C.	Yes	1-A-4
S&R 3-7	Study to determine consumer preferences and consumption patterns for various types of fluid milk.**	Washington, D.C.	Yes	1-A-3
S&R 3-8	Consumer preferences, usages, and buying practices for poultry.	Washington, D.C.	Yes	1-A-2
S&R 3-9	Consumer interest in retail availability of ripe winter pears.	Washington, D.C.	No	
S&R 3-10	Women's attitudes toward cotton and other fibers used in wearing apparel.	Washington, D.C.	Yes	1-A-1
S&R 3-11	Laboratory sensory evaluation of agricultural commodities.	Washington, D.C.	Yes	1-B
S&R 3-12	Consumer preferences, usages, and buying practices for selected types of potato, rice, and wheat products.*	Washington, D.C.	Yes	1-A-5
S&R 3-13	Consumer acceptance of dry whole milk.*	Washington, D.C.	Yes	1-A-3
E9-SRS-1(a)	Factors of food selection other than nutritional and palatability, i.e., psychological factors of food preferences and consumption.	Washington, D.C.	No	
S&R 4	Improvement of Crop and Livestock Estimating Methods.			
S&R 4-1	Studies on the relationship of early-season plant observations made on sorghum and pasture grasses to final yield.	Ames, Iowa	Yes	2-A-7
S&R 4-3	Development of improved sample survey procedures for crop and livestock estimates in Western States.	Wash., D.C. and State offices in Ariz., Calif., Colo., Idaho, Mont., Nev., N. Mex., Oreg., Utah, Wash., & Wyo.	No	2-A-8
S&R 4-5 (rev.)	Development of improved forecasts and estimates of wheat yields.	Wash., D.C. and State offices in Tex., Okla., Ill., Ind., Kans., Mich., Mo., Nebr., Ohio, Colo., Mont., Idaho, Wash., Oreg., S. Dak., N. Dak., & Minn.	Yes	2-A-1
S&R 4-6	Development of improved forecasts and estimates of soybean yields in the selected States.	Wash., D.C. and State offices in Ark., Ill., Ind., Iowa, Kans., Mich., Minn., Miss., Mo., Nebr., & Ohio	Yes	2-A-3

*Initiated during reporting year.

**Discontinued during reporting year.

Line Project Check List -- Reporting Year July 1, 1964 to June 30, 1965

Work & Line Project Number	Work and Line Project Titles	Work Locations During Past Year	Line Proj. Incl. in	
			Summary of progress	Area & sub- heading
S&R 4-8	Improvement of yield forecasts on sour cherries and apples through objective fruit counts and measurements.	Wash., D.C. and State office in Michigan	No	2-A-2
S&R 4-9	Development of improved forecasts for the yield of irrigated cotton.	Wash., D.C. and State offices in N. Mex., Ariz., & Calif.	Yes	2-A-4
S&R 4-10	Probability mailing list from screened segments.	Wash., D. C.	Yes	2-B-3
S&R 4-11	Study of the farm operator as a supplier of agricultural statistics.**	Raleigh, N.C.	No	
S&R 4-12	Study of lists of farm operators as sampling frames for collecting agricultural statistics.	Wash., D.C. and all continental States	Yes	2-B-2
S&R 4-13	Study of response and other non-sampling errors.	Wash., D.C. and Iowa & Ala.	No	2-B-1
S&R 4-14 (rev.)	Study of aerial photography as a supplementary survey technique in making crop and livestock estimates.	Wash., D.C. and all continental States	Yes	2-B-4
S&R 4-15	Development of improved sample survey procedures for crop and livestock estimates in northeastern States, Florida, Texas, Oklahoma, and other States.*	Wash., D.C. and State offices in New England, N.Y., N.J., Pa., Md., Del., W. Va., Fla., Tex., & Okla.	Yes	2-B-5

* Initiated during reporting year.

** Discontinued during reporting year.

